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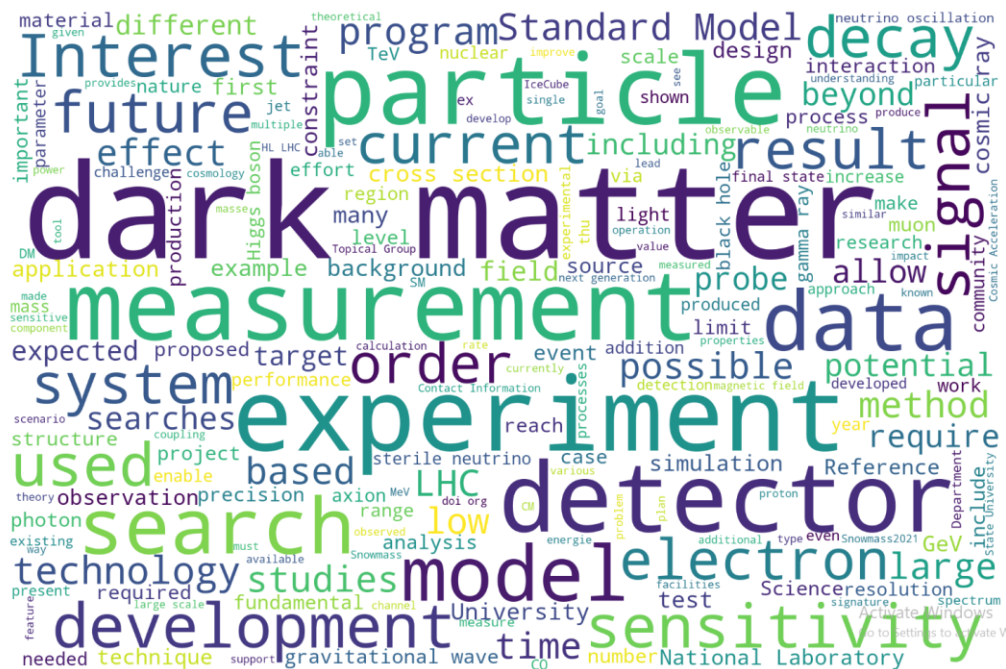
tf8-tf11 Loi Validating a Maximally Natural Electromagnetic Model of the Four Forces

(1) quantized electromagnetic impedance matching of

(2) geometric wavefunction interactions

Two fundamental conceptual structures absent from
the Standard Model

All data is consistent with massless oscillation.



the ‘theoretical minimum’

geometry
point, line, plane, volume

space
3D Pauli algebra
1 scalar, 3 vectors, 3 bivectors, 1 trivector
vacuum wavefunction

fields
five fundamental constants
 e, ϵ_0, c, h, m_e

positron wavefunction **interaction** electron wavefunction

spacetime
4D Dirac algebra
S-matrix of observables

thank you Gordon Watts

geometric product

Given two vectors W and Z , the geometric product WZ changes grades. In the product

$$WZ = W \cdot Z + W \wedge Z,$$

two grade 1 vector bosons transform into a grade 0 scalar boson and grade 2 bivector fermion,

$$WZ = \text{Higgs} + \text{top}.$$

In the geometric representation, Pauli matrices are basis vectors of 3D space,
Dirac matrices of 4D spacetime

Naturalness begets Naturalness: An Emergent Definition [the paper](#)

Peter Cameron and Michael Suisse*

P.O. Box 1030, Mattituck, NY 11952

(Dated: August 3, 2019)

We offer a model based upon three ‘assumptions’. The first is geometric, that the vacuum wavefunction is comprised of Euclid’s fundamental geometric objects of space - point, line, plane, and volume elements - components of the geometric representation of Clifford algebra. The second is electromagnetic, that physical manifestation follows from introducing the dimensionless coupling constant α . The third takes the electron mass to define the scale of space. Such a model is arguably maximally ‘natural’. Wavefunction interactions are modeled by the geometric product of Clifford algebra. What emerges is more naturalness. We offer an emergent definition.

0. Introduction

“...naturalness seems to be one of the best-kept secrets of physicists from the general public, a secret weapon for evaluating and motivating theories of the world on its deepest levels” [1].

- [6] G. Giudice, “Naturally Speaking: The Naturalness Criterion and Physics at the LHC” (2008) <https://arxiv.org/abs/0801.2562> betwixt and between lay the desert
- [7] G. Giudice, “The Dawn of the Post-Naturalness Era” (2017) <https://arxiv.org/abs/1710.07663>
- [8] S. Hossenfelder, “Screams for Explanation: Finetuning and Naturalness in the Foundations of Physics” (2018)

impedance matching governs amplitude and phase of energy/information transmission
scale invariant and dependent impedances correspond to rotation and translation gauge fields

all rest mass particles have
mechanical impedances!
SI units [kg/s]

Electron Impedances

Apeiron, Vol. 18, No. 2, April 2011

Peter Cameron

Brookhaven National Laboratory

Upton, NY 11973

cameron@bnl.gov

It is only recently, and particularly with the quantum Hall effect and the development of nanoelectronics, that impedances on the scale of molecules, atoms and single electrons have gained attention. In what follows the possibility that characteristic impedances might be defined for the photon and the single free electron is explored in some detail, the premise being that the concepts of electrical and mechanical impedances are relevant to the elementary particle. The scale invariant quantum Hall impedance is pivotal in this exploration, as is the two body problem and Mach's principle.

To understand the electron would be enough - Einstein

July 24, 1975

THE TWO BODY PROBLEM AND MACH'S PRINCIPLE

Peter Cameron

2210 Water Street

Port Huron, Michigan 48060

submitted to AJP 1975
published as an appendix to
the [electron impedances paper](#)

The classical analysis of the two-body problem is frequently complicated by the introduction of a system of co-ordinates which is independent of either of the bodies.

vibratory piledriver

two synchronized counter-rotating eccentrics
transforms 2D rotation to 1D translation.

mechanical analogy of electron and positron spinors
rotating in opposite directions in phase space

The 1975 paper drove the inquiry – contained
classical and quantum mechanics and gravitation.

Topological inversion of SI units - more impedance
[kg/s] means less flow, not more!

This thwarted Bjorken, Feynman, many others.

Generalized Quantum Impedances: A Model for the Unstable Particles

background
independent

Peter Cameron*
Brookhaven National Laboratory
Upton, NY USA 11973

(Dated: June 20, 2012)

The discovery of exact impedance quantization in the quantum Hall effect was greatly facilitated by scale invariance. Both follow from the application of the Lorentz force to a two dimensional ballistic current carrier. This letter speculates upon the possibility that quantum impedances may be generalized, defined not just for the Lorentz force, but rather for all forces, resulting in a precisely structured network of scale dependent and scale invariant impedances. If the concept of generalized quantum impedances correctly describes the physical world, then in quantum physics such impedances govern how energy is transmitted and reflected, how the hydrogen atom is ionized by a 13.6eV photon, or why the π_0 branching ratio is what it is. An impedance model of the electron is presented, and explored as a model for the unstable particles as well.

“If you had only one slide
to get your point across...”

Michaele Suisse

The ‘One Slide’ Introduction to **Generalized** Quantum Impedances

Peter Cameron

July 2014

“To understand the electron would be enough”

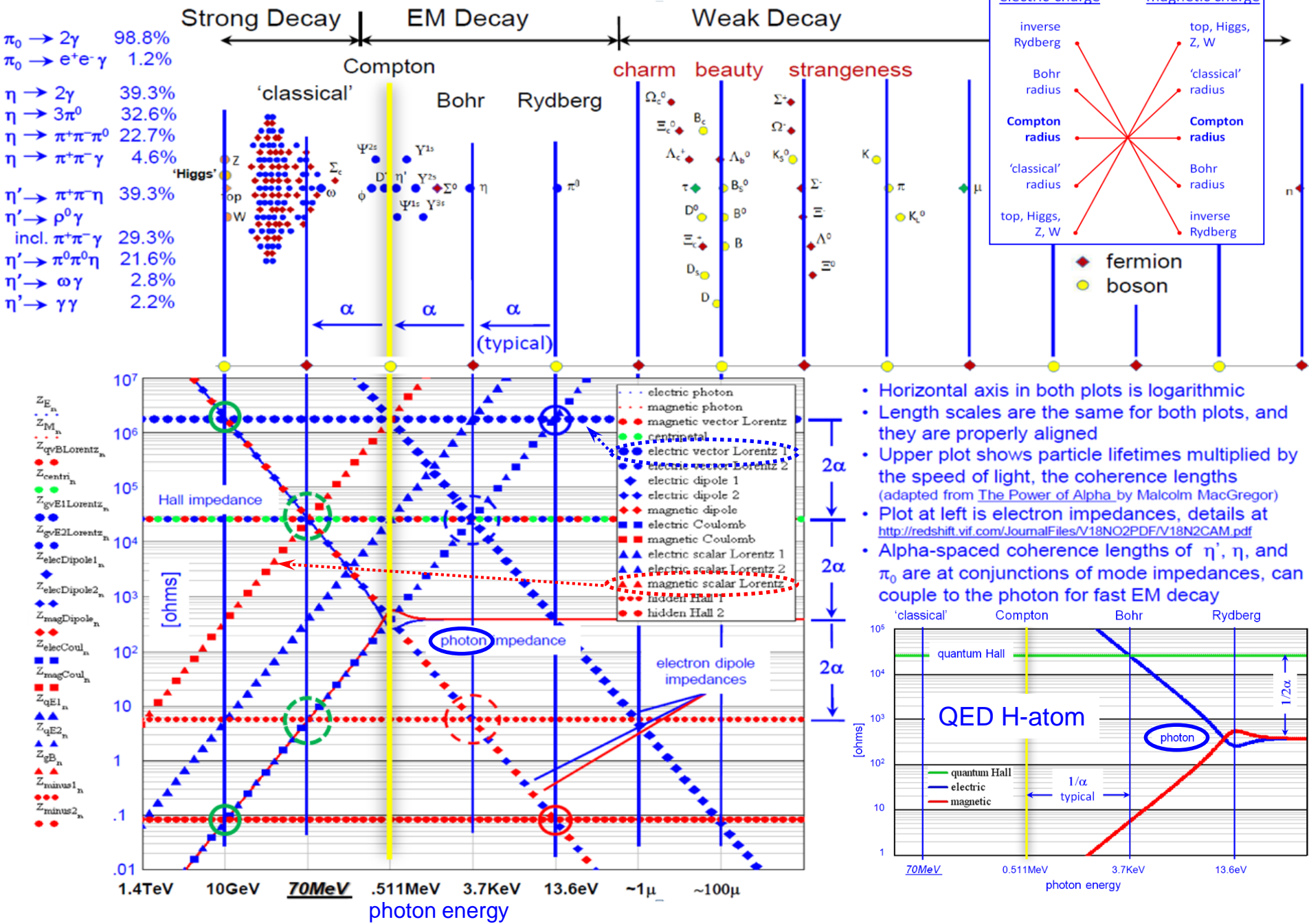
Einstein

*This [‘One Slide’ presentation](#) is a good overview,
but somewhat out of date.*

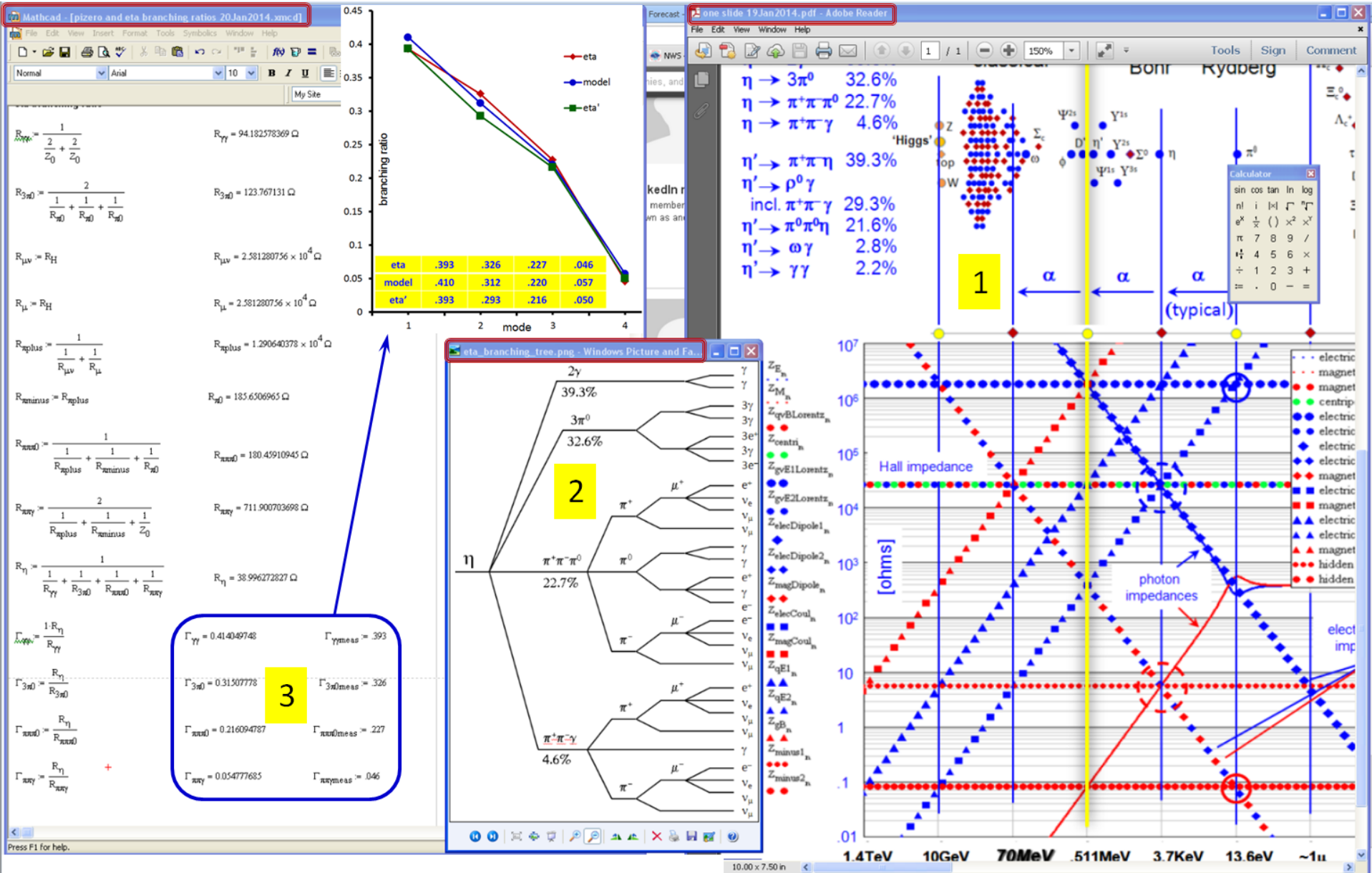
*The [‘Naturalness’ paper](#) is a good complement,
and more complete and current.*

BSM example 1 – unstable particle lifetimes, H-atom, quantum Hall,...

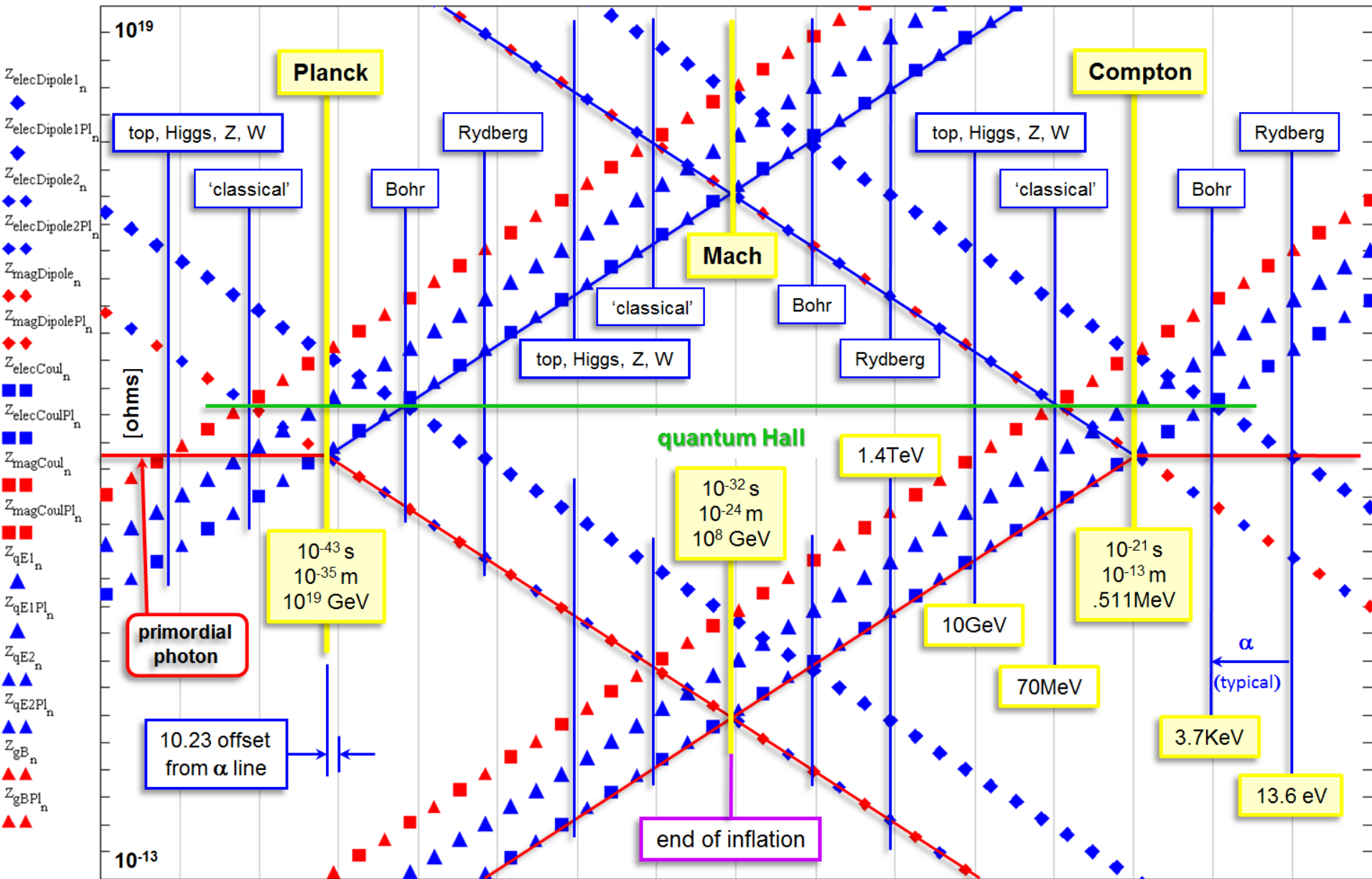
topological inversion



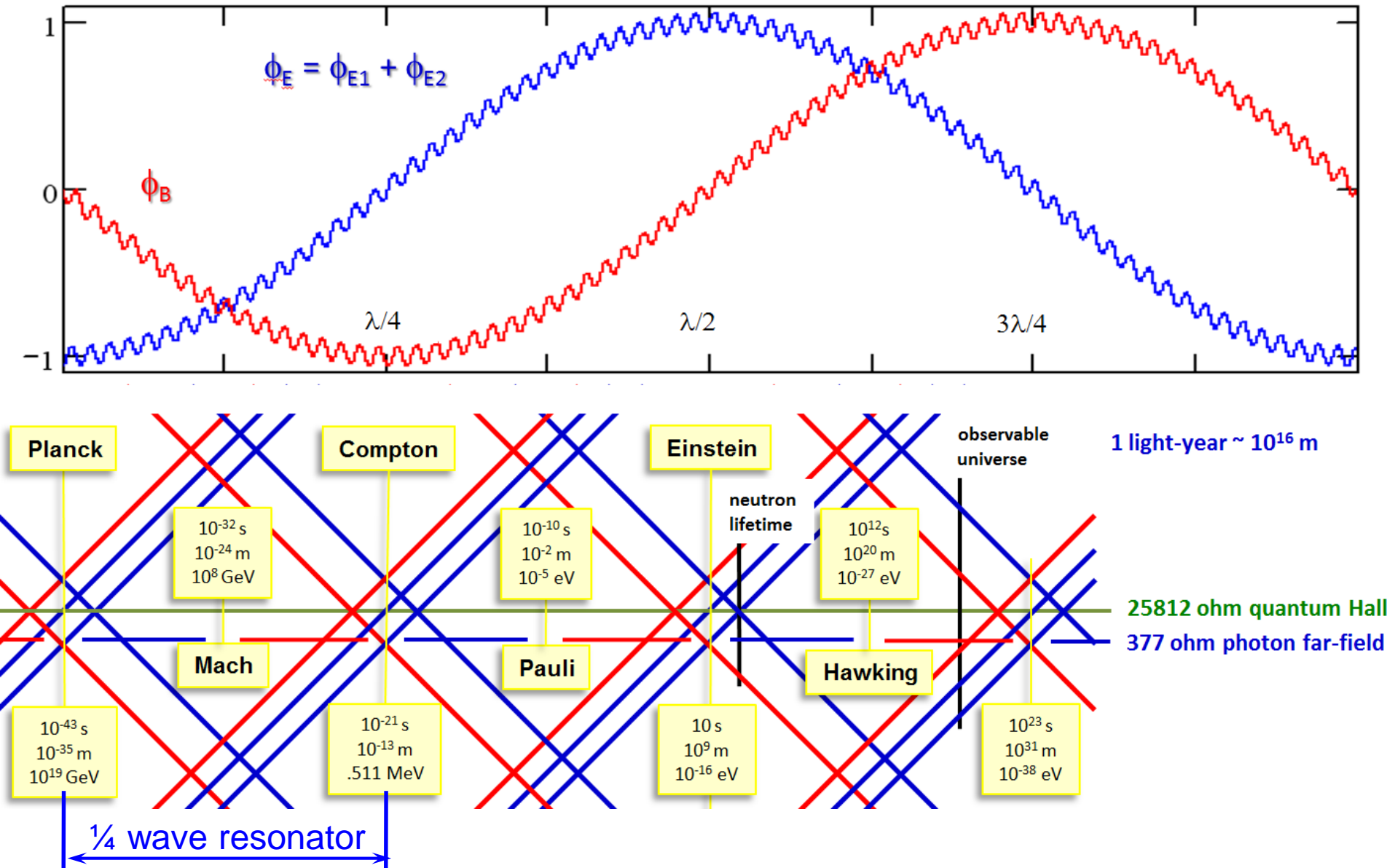
BSM example 2 – chiral anomaly – precise pizero, eta, and eta' branching ratios in powers of α



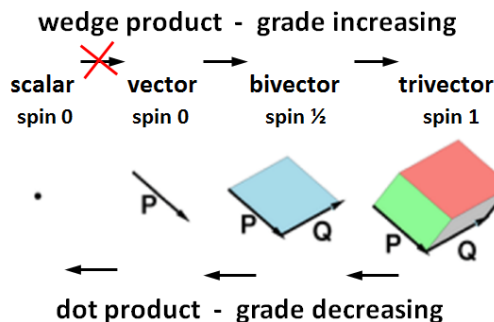
BSM example 3 – origin of mass, gravitation, inflation, chirality, baryon asymmetry,...



BSM example 4 – mismatched attenuated Planck photon – dark energy?



	electric charge e scalar	elec dipole moment 1 d_{E1} vector	elec dipole moment 2 d_{E2} vector	mag flux quantum ϕ_B vector	elec flux quantum 1 ϕ_{E1} bivector	elec flux quantum 2 ϕ_{E2} bivector	magnetic moment μ_{Bohr} bivector	magnetic charge g trivector
e	ee scalar	ed_{E1}	ed_{E2} vector	$e\phi_B$	$e\phi_{E1}$ bivector	$e\phi_{E2}$ bivector	$e\mu_B$	eg trivector
d_{E1}	$d_{E1}e$	$d_{E1}d_{E1}$	$d_{E1}d_{E2}$	$d_{E1}\phi_B$	$d_{E1}\phi_{E1}$	$d_{E1}\phi_{E2}$	$d_{E1}\mu_B$	$d_{E1}g$
d_{E2}	$d_{E2}e$	$d_{E2}d_{E1}$	$d_{E2}d_{E2}$	$d_{E2}\phi_B$	$d_{E2}\phi_{E1}$	$d_{E2}\phi_{E2}$	$d_{E2}\mu_B$	$d_{E2}g$
ϕ_B	$\phi_B e$ vector	$\phi_B d_{E1}$	$\phi_B d_{E2}$ scalar + bivector	$\phi_B \phi_B$	$\phi_B \phi_{E1}$ vector + trivector	$\phi_B \phi_{E2}$ vector + trivector	$\phi_B \mu_B$	$\phi_B g$ scalar Lorentz bv + qv
ϕ_{E1}	$\phi_{E1} e$	$\phi_{E1} d_{E1}$	$\phi_{E1} d_{E2}$	$\phi_{E1} \phi_B$ γ	$\phi_{E1} \phi_{E1}$	$\phi_{E1} \phi_{E2}$	$\phi_{E1} \mu_B$	$\phi_{E1} g$ vector Lorentz
ϕ_{E2}	$\phi_{E2} e$	$\phi_{E2} d_{E1}$	$\phi_{E2} d_{E2}$	$\phi_{E2} \phi_B$	$\phi_{E2} \phi_{E1}$	$\phi_{E2} \phi_{E2}$	$\phi_{E2} \mu_B$	$\phi_{E2} g$
μ_B	$\mu_B e$ bivector	$\mu_B d_{E1}$	$\mu_B d_{E2}$ vector + trivector	$\mu_B \phi_B$	$\mu_B \phi_{E1}$	$\mu_B \phi_{E2}$ scalar + quadvector	$\mu_B \mu_B$	$\mu_B g$ vector + pv
g	ge trivector	gd_{E1} bivector + quadvector	gd_{E2}	$g\phi_B$	$g\phi_{E1}$ vector + pentavector	$g\phi_{E2}$ vector + pentavector	$g\mu_B$	gg scalar + sv



impedance representation of the S-matrix

Dirac spinors are indicated by gold ellipses, neutrino by green

neutrino wavefunction is 3-body,

3-body impedance is scale invariant – **topological**

modes indicated by symbols (diamonds,...)

are plotted in next slide

$$\psi_\nu = \phi_B \phi_{E1} g$$

Neutrino modes as PMNS 'mass states'

$$\begin{bmatrix} \nu_e \\ \nu_\mu \\ \nu_\tau \end{bmatrix} = \begin{bmatrix} .82 & .36 & .4 \\ .55 & .5 & .6 \\ .15 & .7 & .7 \end{bmatrix} \begin{bmatrix} \phi_E \phi_B \\ g\phi_E \\ g\phi_B \end{bmatrix}$$

$$\nu_e = \begin{matrix} \phi_E \phi_B & g\phi_E & g\phi_B \\ .82^2 \sim 2/3 & .36^2 \sim 1/6 & .4^2 \sim 1/6 \end{matrix}$$

$$\nu_\mu = \begin{matrix} \phi_E \phi_B & g\phi_E & g\phi_B \\ .55^2 \sim 1/3 & .5^2 \sim 1/3 & .6^2 \sim 1/3 \end{matrix}$$

$$\nu_\tau = \begin{matrix} \phi_E \phi_B & g\phi_E & g\phi_B \\ .15^2 \sim .02 & .7^2 \sim 1/2 & .7^2 \sim 1/2 \end{matrix}$$

$$\nu_e = \begin{matrix} \phi_E \phi_B & g\phi_E & g\phi_B \\ 2/3 & 1/6 & 1/6 \end{matrix}$$

$$\nu_\mu = \begin{matrix} \phi_E \phi_B & g\phi_E & g\phi_B \\ 1/3 & 1/3 & 1/3 \end{matrix}$$

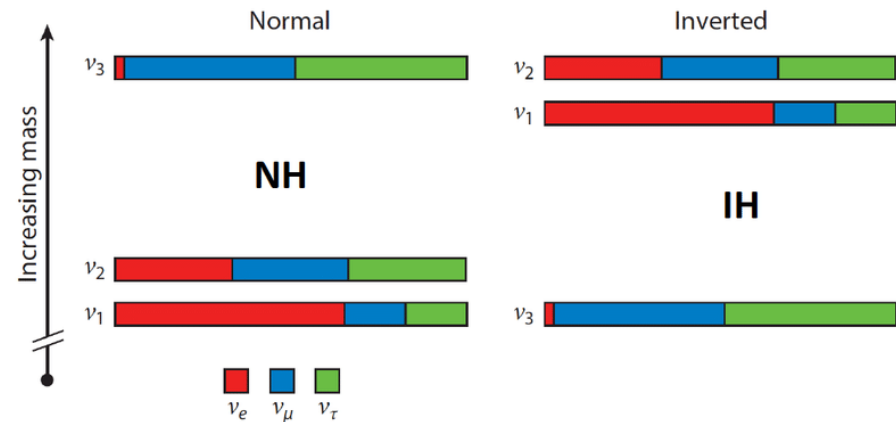
$$\nu_\tau = \begin{matrix} \phi_E \phi_B & g\phi_E & g\phi_B \\ .02 & 1/2 & 1/2 \end{matrix}$$

Magnetic charge (trivector) and flux quantum (vector) are numerically equal (SI units) but topologically distinct.

Adding magnetic charge to photon to comprise the neutrino is topological.

Photon is topologically protected.

Absence of right handed neutrino follows from the math - octonion algebra of eight-component wavefunction is not three-component associative.



please note inversion of modes and wavefunctions in these two figures – not sure where things got flipped

8-component octonion wavefunction is the eight degree-of-freedom string of string theory. The octonion gains two additional DOFs from assigning E and B fields to the components, yielding the ten dimensions of string theory.

Summary

two fundamental concepts are absent from SM, both ‘historical accidents’
geometric representation of Clifford algebra – vacuum wavefunction
generalized quantum impedances – governs amplitude and phase
their restoration yields a model that is **naturally**
gauge invariant, finite, confined, asymptotically free,
and contains the four forces, dark matter and energy,...
a model that provides a complementary perspective to SM

Conclusion

The tf08-tf11 Loi requests that the community become pro-active
“Validating a Maximally Natural Electromagnetic Model of the Four Forces”

If the model is what it appears to be,
then reasonable and prudent behavior suggests including it where relevant
in our recommendations to P5.

Weak Decay

$$\eta \rightarrow \pi^+\pi^-\gamma \quad 4.6\%$$
 $\eta' \rightarrow \omega \gamma$ 2.8%
$$\eta' \rightarrow \gamma\gamma \quad 2.2\%$$

charm beauty strangeness

showing quark content

- boson

